Invoice

Moffatt & Nichol

P.O. Box 22648

Long Beach, CA 90801-5648
Phone: (562) 590-6500

Robert Law
De Maximis Inc.
186 Center Street, Suite 290
Clinton, NJ 08809

October 26, 2015
Invoice No: 714017

Project 6664-04 Lower Passaic River/Newark Bay Modeling

Professional Services from August 30, 2015 to September 26, 2015

LPR/NB Modeling Program NB Model of the LPR/NB

Task 01 Coordination and Meetings
Coordination and Meetings

Professional Personnel

	Hours	Rate	Amount	
Senior Engineer/Scientist	11.00	209.00	2,299.00	
Engineer/Scientist II	5.50	172.00	946.00	
Totals	16.50		3,245.00	
Total Labor				**3,245.00**
			Total this Task	**$3,245.00**

Task 03 System Understanding
System Understanding

Professional Personnel

	Hours	Rate	Amount	
Senior Engineer/Scientist	4.00	209.00	836.00	
Engineer/Scientist II	42.00	172.00	7,224.00	
Staff Engineer/Scientist	40.00	119.00	4,760.00	
Totals	86.00		12,820.00	
Total Labor				**12,820.00**
			Total this Task	**$12,820.00**

Task 04 LPR/NB Hydrodynamic Model
LPR/NB Hydrodynamic Model

Professional Personnel

	Hours	Rate	Amount
Senior Engineer/Scientist	4.00	209.00	836.00

Staff Engineer/Scientist				
	52.00	119.00	6,188.00	
Totals	56.00		7,024.00	
Total Labor				**7,024.00**
			Total this Task	**$7,024.00**

Task 05 LPR/NB Sediment Transport Model

LPR/NB Sediment Transport Model

Professional Personnel

	Hours	**Rate**	**Amount**	
Senior Engineer/Scientist				
	1.00	209.00	209.00	
Engineer/Scientist II				
	30.50	172.00	5,246.00	
Staff Engineer/Scientist				
	60.00	119.00	7,140.00	
Totals	91.50		12,595.00	
Total Labor				**12,595.00**
			Total this Task	**$12,595.00**
			Total this Phase	**$35,684.00**
			TOTAL THIS INVOICE	**$35,684.00**

ACH Payment Remittance Information
Bank Account Name: Moffatt & Nichol
Bank Number: 4159349729
Routing: 121000248

Billing Backup

Friday, October 30, 2015

1:23:56 PM

Moffatt & Nichol

Invoice 714017 Dated 10/26/2015

Project 6664-04 Lower Passaic River/Newark Bay Modeling

LPR/NB Modeling Program NB Model of the LPR/NB

Task 01 Coordination and Meetings

Coordination and Meetings

Professional Personnel

			Hours	Rate	Amount	
Senior Engineer/Scientist						
1548	Canizares, Rafael	8/31/2015	1.50	209.00	313.50	
1548	Canizares, Rafael	9/1/2015	.50	209.00	104.50	
1548	Canizares, Rafael	9/8/2015	2.00	209.00	418.00	
1548	Canizares, Rafael	9/9/2015	4.00	209.00	836.00	
1548	Canizares, Rafael	9/14/2015	1.00	209.00	209.00	
1548	Canizares, Rafael	9/22/2015	2.00	209.00	418.00	
Engineer/Scientist II						
2219	Mathew, Rooni	9/15/2015	1.00	172.00	172.00	
2219	Mathew, Rooni	9/16/2015	.50	172.00	86.00	
2219	Mathew, Rooni	9/17/2015	2.00	172.00	344.00	
2219	Mathew, Rooni	9/18/2015	2.00	172.00	344.00	
Totals			16.50		3,245.00	
Total Labor						**3,245.00**
				Total this Task		**$3,245.00**

Task 03 System Understanding

System Understanding

Professional Personnel

			Hours	Rate	Amount
Senior Engineer/Scientist					
1548	Canizares, Rafael	9/23/2015	1.00	209.00	209.00
1548	Canizares, Rafael	9/24/2015	1.00	209.00	209.00
1548	Canizares, Rafael	9/25/2015	2.00	209.00	418.00
Engineer/Scientist II					
2219	Mathew, Rooni	9/14/2015	8.00	172.00	1,376.00
2219	Mathew, Rooni	9/15/2015	7.00	172.00	1,204.00
2219	Mathew, Rooni	9/16/2015	7.50	172.00	1,290.00
2219	Mathew, Rooni	9/17/2015	6.00	172.00	1,032.00
2219	Mathew, Rooni	9/18/2015	6.00	172.00	1,032.00
2219	Mathew, Rooni	9/21/2015	3.50	172.00	602.00
2219	Mathew, Rooni	9/23/2015	2.00	172.00	344.00
2219	Mathew, Rooni	9/25/2015	2.00	172.00	344.00
Staff Engineer/Scientist					
2301	Manian, Dinesh	8/31/2015	8.00	119.00	952.00
2301	Manian, Dinesh	9/11/2015	8.00	119.00	952.00

2301	Manian, Dinesh	9/15/2015	8.00	119.00	952.00	
2301	Manian, Dinesh	9/21/2015	8.00	119.00	952.00	
2301	Manian, Dinesh	9/22/2015	8.00	119.00	952.00	
Totals			86.00		12,820.00	
Total Labor						**12,820.00**
				Total this Task		**$12,820.00**

Task 04 LPR/NB Hydrodynamic Model

LPR/NB Hydrodynamic Model

Professional Personnel

			Hours	**Rate**	**Amount**	
Senior Engineer/Scientist						
1548	Canizares, Rafael	9/10/2015	1.00	209.00	209.00	
1548	Canizares, Rafael	9/14/2015	2.00	209.00	418.00	
1548	Canizares, Rafael	9/22/2015	.50	209.00	104.50	
1548	Canizares, Rafael	9/23/2015	.50	209.00	104.50	
Staff Engineer/Scientist						
2301	Manian, Dinesh	9/1/2015	8.00	119.00	952.00	
2301	Manian, Dinesh	9/8/2015	8.00	119.00	952.00	
2301	Manian, Dinesh	9/14/2015	8.00	119.00	952.00	
2301	Manian, Dinesh	9/16/2015	8.00	119.00	952.00	
2301	Manian, Dinesh	9/17/2015	4.00	119.00	476.00	
2301	Manian, Dinesh	9/23/2015	8.00	119.00	952.00	
2301	Manian, Dinesh	9/24/2015	8.00	119.00	952.00	
Totals			56.00		7,024.00	
Total Labor						**7,024.00**
				Total this Task		**$7,024.00**

Task 05 LPR/NB Sediment Transport Model

LPR/NB Sediment Transport Model

Professional Personnel

			Hours	**Rate**	**Amount**	
Senior Engineer/Scientist						
1548	Canizares, Rafael	9/8/2015	1.00	209.00	209.00	
Engineer/Scientist II						
2219	Mathew, Rooni	9/8/2015	8.00	172.00	1,376.00	
2219	Mathew, Rooni	9/9/2015	8.00	172.00	1,376.00	
2219	Mathew, Rooni	9/10/2015	8.00	172.00	1,376.00	
2219	Mathew, Rooni	9/11/2015	3.50	172.00	602.00	
2219	Mathew, Rooni	9/21/2015	2.00	172.00	344.00	
2219	Mathew, Rooni	9/24/2015	1.00	172.00	172.00	
Staff Engineer/Scientist						
2301	Manian, Dinesh	9/2/2015	8.00	119.00	952.00	
2301	Manian, Dinesh	9/3/2015	8.00	119.00	952.00	
2301	Manian, Dinesh	9/4/2015	8.00	119.00	952.00	
2301	Manian, Dinesh	9/9/2015	8.00	119.00	952.00	
2301	Manian, Dinesh	9/10/2015	8.00	119.00	952.00	
2301	Manian, Dinesh	9/17/2015	4.00	119.00	476.00	
2301	Manian, Dinesh	9/18/2015	8.00	119.00	952.00	
2301	Manian, Dinesh	9/25/2015	8.00	119.00	952.00	
Totals			91.50		12,595.00	
Total Labor						**12,595.00**

Project	6664-04	Lower Passaic River/Newark Bay Modeling	Invoice	714017

Total this Task	**$12,595.00**
Total this Phase	**$35,684.00**
Total this Project	**$35,684.00**
Total this Report	**$35,684.00**

MOFFATT & NICHOL

529 5th Avenue
14th floor
New York, NY 10017

(212) 768-7454
Fax (212) 768-7936

Detailed Description of work done by M&N personnel associated to the LPR/NB Modeling Program HD/ST Newark Bay Model - Scope of Work for the period 08/30/2015 to 09/26/2015 M&N Project No. 6664

Hydrodynamics Principal Investigator - Rafael Cañizares.

Task 1 – Project Management	• Internal coordination with Deltares and M&N, tasks to be completed • Prepare and review July invoice • Internal project accounting. • Review with Deltares invoicing. • Internal discussion with Dinesh Manian regarding project tasks • Review invoice • Internal coordination • Internal coordination with Deltares for invoice
Task 3 – LPR/NB System Understanding	• Review and update System Understanding report
Task 4 – LPR/NB Hydrodynamic Modeling	• Discuss and review model results and approach for calibration • Discuss calibration procedure and model improvements.
Task 5 – LPR/NB Sediment Transport Modeling	• Internal discussion and review of ST model developments

Rooni Mathew.

Task 1 – Project Management	• Compile material to share with AQEA and respond to AQEA's questions • Respond to HQI conference call on PWCM data • Respond to HQI questions on PWCM data
Task 3 – System Understanding	• Review velocity profiles from Bob Chant & PWCM deployments, review tide/current deformation and lag data, review comparisons to tide, wind, discharge data • Develop./finalize hydro calibration metrics based on PWCM/Chant data analysis, review model performance, develop/review sensitivity tests • Develop/review wind-wave shear stress environment and statistics • Develop/review wind-wave shear stress environment and statistics, compare to sediment GSD data

	• Develop wave shear stress statistics and maps, compare wave shear stresses to sediment substrate • Finish wave shear stress and surface GSD comparisons, review with H.Winterwerp • Review wave model skin friction with H.Winterwerp, review system understanding document • Develop. Re-entrainment rate analysis for NB
Task 5 – LPR/NB Sediment Transport Modeling	• Review & debug wind-wave runs w ST • Review/finalize codes for wind-wave shear stress calculations and combined current/wave shear stress, process/review ST run with Hackensack River changes, wind-waves • Review HQI suggested sensitivity runs for Hackensack River/Meadowlands, review ST run with Hackensack River • Develop revised bathy inputs and launch ST run with revised Hackensack River geometry/friction • Review progress of ST run with revised grid/friction

Dinesh Manian

Task 3 – System Understanding	• Computing sediment flux at KVK based on Chant's2001-02 data; Updated sediment flux based on Chant's2008-09 sediment and bathy data (post-deepening); • Evaluating wave model results; Annual wave rose plots at different locations; comparison with wind data for the same period • Preparing presentation summarizing understanding of system processes, and model performance • Preparing summary presentation for internal review of HD model calibration for Newark Bay; Including data analysis, wave model, and model-data comparisons • Preparing summary presentation for internal review of HD model calibration for Newark Bay; Including data analysis, wave model, and model-data comparisons
Task 4 – LPR/NB Hydrodynamic Modeling	• HD calibration: Processing sensitivity runs to Meadowlands connection; Model-data comparison of the time-series of phase difference between slack-water at LPR and Hackensack • HD calibration: Additional Sensitivity runs to Meadowlands connection w Hackensack; Model-data comparison of the time-series of velocity phase difference between Passaic and Hackensack • HD calibration Sensitivities to meadowlands bathymetry

	• HD calibration: Processing time-series of slack-water phase-difference in the model; Comparison with data • HD calibration: Additional sensitivities to bottom-friction and Meadowlands bathymetry • Setting up long-term hydrodynamic simulations with full grid with revised Hackensack bathymetry • QA/QC and understanding wave model results; Time-series of wave-maps, and correlation with winds
Task 5 – LPR/NB Sediment Transport Modeling	• Developing model-data comparison in Newark Bay with Chant's 2008-09 and Spring PWCM data; • Setting up tabulation of sediment mass balance in the model in Newark Bay • Setting up tabulation of annual sediment mass balance in the model in Newark Bay • Debugging ST code with waves; • Debugging ST code with waves; Assessing model performance with updated code • Understanding ST model performance with waves; Processing time-series of maps of wave-heights and shear-stresses • Processing ST model mass-balance in Newark Bay • Processing final ST model run with waves